

Special issue: new federal airbag rule

STATUS REPORT

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For the first time

the federal government has issued a regulation to protect people from the safety systems in their cars. Besides assuring that airbags will continue to prevent deaths and injuries in serious crashes, the new standard for occupant protection is designed to make

airbags safer for out-of-position occupants. Airbags already have saved thousands of lives. But inflating airbags have killed about 160 people in relatively low-severity crashes in which serious injuries otherwise would have been unlikely. Plus airbags have caused some deaths and injuries to out-of-position (predominantly unbelted) people in higher severity crashes. Indications are that newer airbag designs and efforts to educate motorists are reducing these problems. The number of airbag deaths appears to be shrinking even as the number of airbag-equipped vehicles increases.

Under consideration for almost two years, the new rule follows a Congressional mandate to improve the protection offered by airbags and minimize their potential to cause harm (see *Status Report*, Oct. 10, 1998; on the web at www.highwaysafety.org). Never before have automakers had to meet such extensive testing requirements (see charts, this page).

But the government isn't closing the book on airbag rulemaking. The National Highway Traffic Safety Administration (NHTSA) says it plans research on a few points it considers to be unresolved, including the controversial issue of the maximum speed of rigid-barrier crash tests using unbelted dummies (see p. 4).

More dummies: Until now, the only dummy required in government airbag tests has been the 50th percentile adult male. Now tests with dummies representing children of various ages and short-stature women will be required.

The 5th percentile adult female has been added to almost all of the crash tests. This dummy also will be used in static tests for out-of-position occupants, which don't involve crashes (see charts, this page). Dummies representing children ages one, three, and six have been added exclusively for static testing and won't be required in any crash tests.

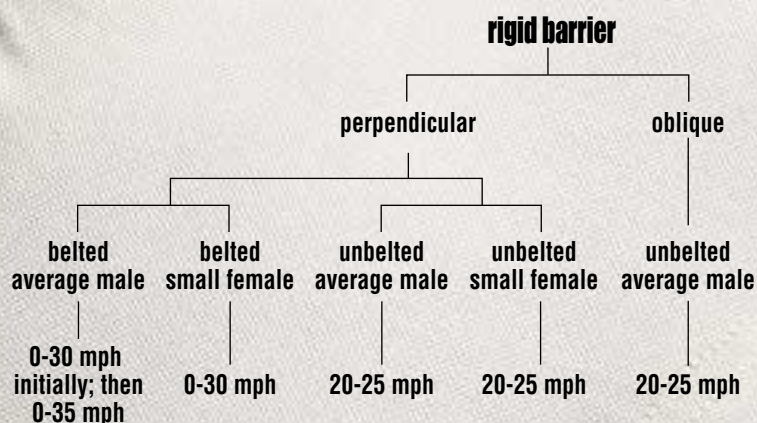
The static tests require either suppression of airbags or inflation with forces that result in dummy injury measures below specified thresholds. This is intended to reduce the dangers of inflating airbags to those most at risk — children and short adults. Of the 162 airbag deaths in low-severity crashes confirmed by NHTSA, 96 were children and at least 22 were relatively short women.

Tests to improve protection: In the past, airbag rules specified crash tests into rigid barriers, both perpendicular (continues on p. 6)



No require

Frontal crash test requ



new test elements

requirements

deformable barrier

offset driver side

belted
small female

0-25 mph

Out-of-position testing

driver

small adult female

low injury
measures when
airbag inflates
as it would in
low-speed crash

OR

suppress airbag
if small female
moves close
to airbag during
crash

passenger

3 & 6 year-olds

low injury
measures when
airbag inflates
as it would in
low-speed crash

OR

suppress airbag
in presence of
child

OR

suppress airbag
if child moves
close to airbag
during crash

1 year-old

low injury
measures when
airbag inflates
as it would in
low-speed crash

OR

suppress
airbag in
presence
of infant

Science prevails

in decision to go with testing with unbelted dummies at 25 mph

Industry, government, and safety groups agreed on virtually all of the requirements proposed in the complex airbag rulemaking (see p. 1). The lone issue that sparked intense debate was whether the maximum speed of rigid-barrier crash tests with unbelted dummies should be 25 or 30 mph.

After months of consideration, the National Highway Traffic Safety Administration

(NHTSA) went with the 25 mph test speed. The agency says its "initial inclination" was toward the higher speed but later concluded it "would not be in the best interest of safety."

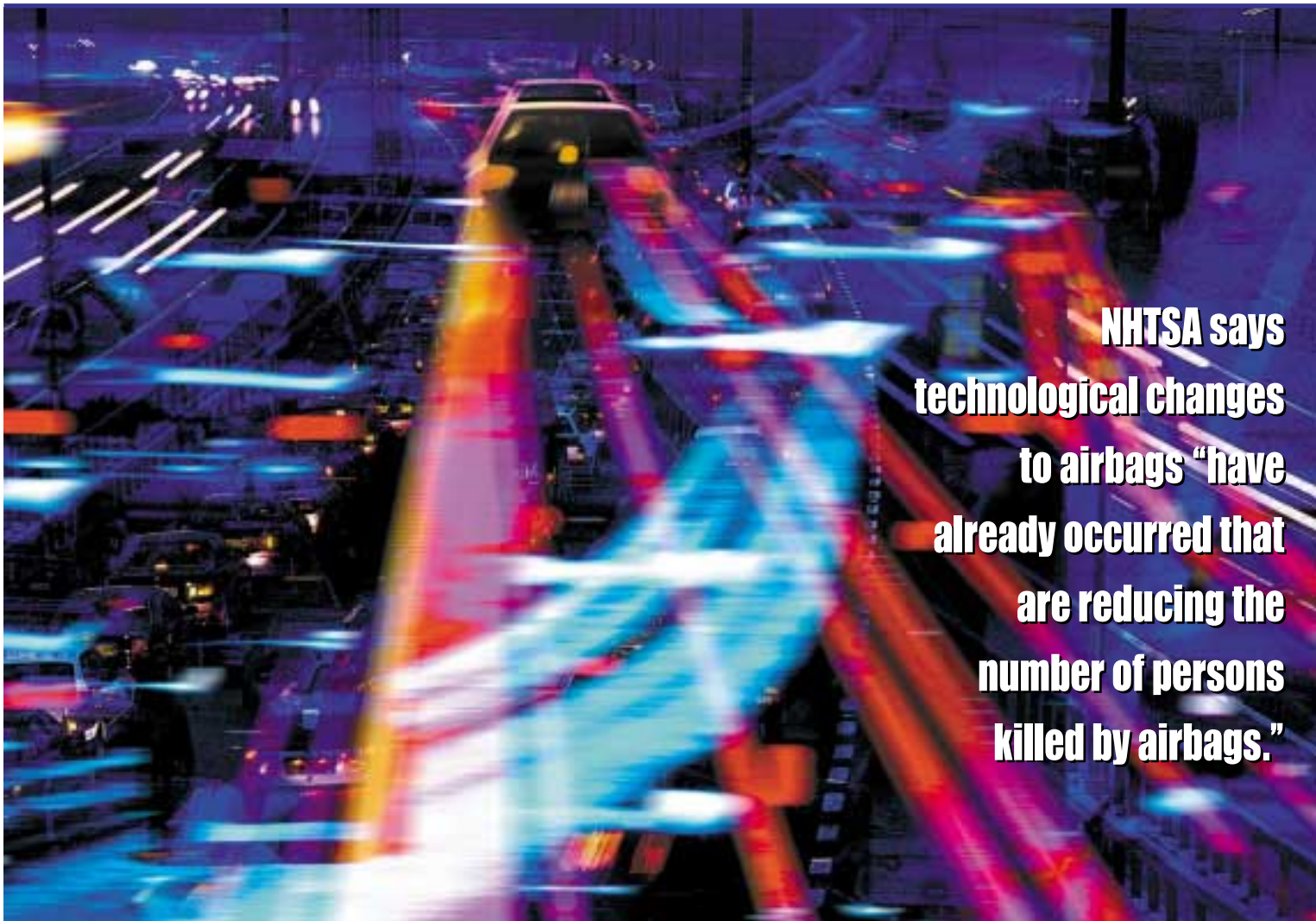
Pros and cons: The main claims before the agency from those supporting the 30 mph test speed were that half of all frontal crash deaths occur in impacts with velocity changes greater than this, and 30 mph testing wouldn't prompt a return to more aggressive airbags because almost all vehicles now meet such requirements with adult male dummies. Another claim was that the lower speed of 25 mph would fail to encourage advanced airbags.

On the other hand, advocates of 25 mph testing told NHTSA the higher speed would prompt a return to overly aggressive airbags, which can cause deaths in low- and high-speed crashes. Depowered airbags are providing effective protection in crashes at higher speeds

while reducing harm to people in low-speed crashes. No convincing evidence was presented to indicate the lower test speed would decrease protection for people without belts.

Problems with 30 mph tests: "We firmly believe NHTSA made the right decision, going with the 25 mph speed," Institute president Brian O'Neill says. "While it may seem counterintuitive that higher test speeds don't necessarily lead to better protection in real-world crashes at higher speeds, the available evidence indicates that rigid-barrier tests conducted at 25 mph with unbelted dummies will result in better protection for unbelted people than if the same tests were run at 30 mph."

At issue is the airbag energy necessary to protect people, O'Neill further explains. "Higher test speeds require more airbag energy, and when occupants, usually unbelted, are out of position in their vehicles, airbag energy can



NHTSA says technological changes to airbags "have already occurred that are reducing the number of persons killed by airbags."

be harmful rather than protective. So the key is whether there's any convincing evidence that today's depowered airbags have insufficient energy to protect people in crashes at higher speeds. And the answer, based on our review of cases from federal data files involving driver deaths in frontal crashes, is that none of the 'failures' — that is, cases when airbags didn't prevent deaths — occurred because of insufficient inflation energy. Instead, the deaths occurred because of major intrusion into the occupant compartments, or the occupants were ejected, or because of the inflation energy of the airbags themselves."

Neither intrusion nor ejection are addressed in the current airbag rule. However, airbag inflation energy is driven by the test speed choice. "Higher speeds mean greater inflation energy, which in turn increases the risks to unbelted people who often are out of

position when their airbags begin to inflate. These increased risks aren't offset by any increase in the protection airbags afford. This is why the Institute opposed the 30 mph test speed. Adopting it would degrade rather than enhance overall protection for unbelted people," O'Neill says.

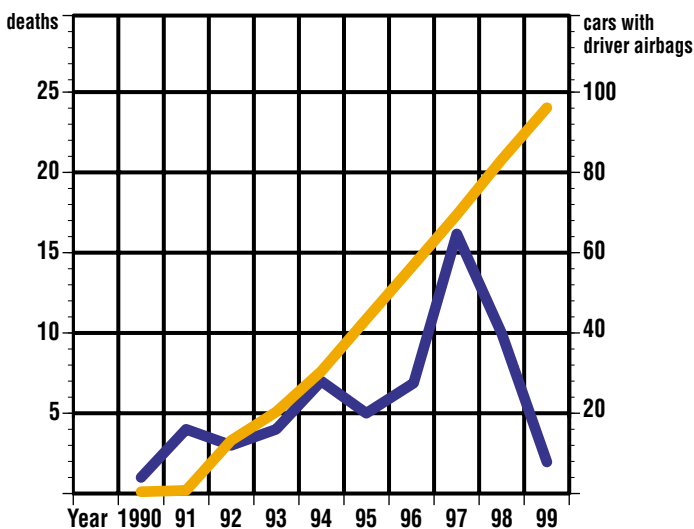
He further notes that "it's misleading to say more than half of all frontal crash deaths occur in impacts with velocity changes greater than 30 mph and to imply this is relevant to the choice of a barrier test speed. The velocity changes computed for real-world crashes cannot be directly related to barrier test speeds because, for any velocity change, virtually all real crashes occur over a longer time than rigid-barrier tests. This means the occupant compartment decelerations in real-world crashes are much lower than in rigid-barrier tests, which have very short durations

— no real-world crash could occur over a shorter time. This fact has important implications for airbag performance. Short-duration high-speed barrier tests require airbag inflators to produce more gas faster, whereas many real-world crashes require less gas over a longer time."

Interim decision: NHTSA ultimately didn't agree with all of the arguments against 30 mph testing with unbelted dummies. But the many uncertainties associated with the higher speed were enough to decide the issue at least for the short term. The agency says it drew "no final conclusion about the appropriateness of that test speed in the longer run." Thus the 25 mph requirement has been issued as an interim final rule. Investigations of the real-world performance of depowered and advanced airbags are planned for possible reconsideration of the test speed.

Confirmed deaths from inflating airbags

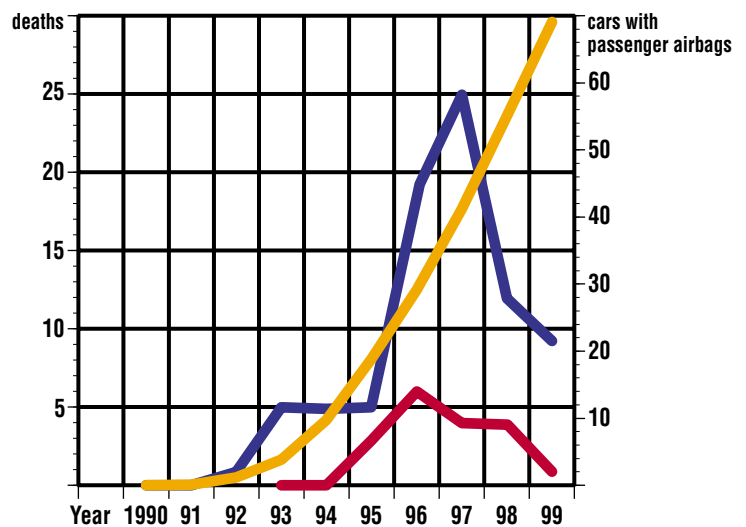
Driver deaths as of May 1, 2000



— number of driver deaths
— number of cars with driver airbags (millions)

Confirmed deaths don't include 12 driver deaths under investigation by the Natl. Highway Traffic Safety Admin.

Infant and child deaths as of May 1, 2000



— number of child deaths
— number of deaths of infants in rear-facing restraints
— number of cars with passenger airbags (millions)

Confirmed deaths don't include 20 child and 3 infant deaths under investigation by the Natl. Highway Traffic Safety Admin.

(continued from p. 2) and at a 30-degree angle, at speeds up to and including 30 mph. These tests have required unbelted and belted 50th percentile adult male dummies. Since 1997, a sled test has been permitted as an alternative to rigid-barrier tests with unbelted dummies.

Rigid-barrier impacts carry over in the new standard. But the maximum speed of 30 mph has been changed to 25 mph for the tests with unbelted dummies, and now such tests will be required for both small female and average-size male dummies. The oblique (30-degree) version of the unbelted barrier test will be required with males only.

The test speed for belted dummies will increase to a maximum of 35 mph starting in 2007, after the rest of the requirements have been fully phased in. This change applies only to male dummies. Some time in the future NHTSA intends to propose the same increase for small females.

The maximum speed of rigid-barrier tests with unbelted dummies prompted intense debate (see p. 4). The final rule eliminates the sled option that had allowed initial depowering of airbags. But instead of returning to the requirement that the unbelted dummy injury criteria be met at speeds up to 30 mph, the new standard specifies rigid-barrier tests from 20 to 25 mph for unbelted dummies. Setting the minimum at 20 mph, instead of 0 mph as in the previous rule, is intended to ensure that automakers aren't inappropriately required to set airbag deployment thresholds too low.

Improving crash sensors: In each of the standard's rigid-barrier crash tests, vehicle front ends hit an unyielding barrier in a perpendicular or oblique impact. The new rule adds a completely different kind of test to the matrix — an offset frontal deformable barrier test using a small female driver dummy.

The impact of 40 percent of the test vehicle's front end into a yielding barrier (impact on the driver side) better approximates some vehicle-to-vehicle crashes. The requirements of this test must be met in the speed range of 0 to 25 mph, replicating the problem that relatively low-speed offset crashes pose for some airbag sensors — the softer "crash pulses" can make it harder to determine whether or when airbags should deploy.

Minimizing the risk of harm: For passenger airbags, the new rule allows manufactur-

ers either to suppress the airbags whenever children are present (static suppression) or to deploy airbags without exceeding the dummy injury criteria (low-risk deployment). This covers infants and children in the front seat, whether or not they're properly secured in a child restraint or booster seat.

The static suppression tests are extensive (see charts, pp. 2-3). When they call for the use of a child restraint, the vehicle must be able to certify using any of the nearly two dozen child restraints specified in the regulation. Each restraint must be tested in multiple positions, both with and without vehicle safety belts and universal child restraint anchors attached. The sensors used for airbag suppression must be able to detect children positioned directly on the seat in numerous ways — sitting down without a seat belt, standing up, kneeling, and lying down on the seat. An airbag system that successfully deactivates for a child dummy also

must demonstrate it doesn't deactivate for a small adult female.

In tests demonstrating low-risk deployment for infant and child passengers, airbags must deploy without significant injury risk in at least two potentially dangerous situations — for example, with a child dummy's head resting against the instrument panel and then, in another test, with the dummy's chest against the panel. Neck and head injury measures on the dummy must stay within established limits. A crash isn't required for the test itself, but a low-speed crash must be conducted beforehand to determine what airbag inflation level (if there's more than one) will be deployed.

All vehicles will include warning labels on sun visors and dashboard.

WARNING

EVEN WITH ADVANCED AIR BAGS



- Children can be killed or seriously injured by an air bag
- The back seat is the safest place for children
- Always use seat belts and child restraints
- See owner's manual for more information about air bags

This Vehicle is Equipped with Advanced Air Bags

Even with Advanced Air Bags

Children can be killed or seriously injured by the

The back seat is the safest place for children

Always use seat belts and child restraints.

See owner's manual for more information about air

Low-risk deployment tests also are an option on the driver side. Similar to the low-risk deployment test for children, this option specifies that the small adult female dummy is sitting forward in the seat and contacting the steering wheel when the airbag deploys. The new rule doesn't allow for suppression of the airbag on the driver side merely because a driver is present in the seat.

For the female dummy on the driver side and for the three- and six-year-old dummies on the passenger side, automakers can choose to meet a third alternative — dynamic suppression. A dynamic system would suppress an airbag when an occupant moves into a zone where inflation injury becomes likely. Multiple dynamic suppression technologies are in development, so rather than specify

procedures NHTSA has proposed expedited rulemaking for any automaker wanting to introduce such technology.

New injury criteria:

The head, neck, chest, and leg injury criteria de-

veloped for the small adult female and child dummies are based on those previously developed for the average-size adult male dummy. A few of these injury measures have been further refined.

NHTSA's proposed new way of computing the head injury criterion (HIC) uses a lower threshold and a shorter time interval. The current standard specifies that the HIC value for the 50th percentile male dummy in rigid-barrier tests must not exceed 1,000 during an interval of 36 milliseconds. The new maximum HIC will be 700 over 15 milliseconds for the adult male and female dummies and for the six-year-old child. This change doesn't make the requirement any more or less demanding but simply makes the measure more consistent with the biomechanics of head injury. Lower HIC values will apply for the smaller child dummies.

NHTSA has adopted separate limits on chest acceleration and deflection to measure potential chest injuries for all dummies except the one representing an infant, to which chest injury criteria don't apply. Chest deflection limits, which measure the compression of the chest relative to the spine, have been lowered and made more stringent. A 60 g chest acceleration limit will continue to apply for adult male and female dummies. A slightly lower limit has been adopted for the others.

Nij is a relatively new injury measure that accounts for flexion, extension, tension, and compression in the neck. Unlike separate limits for each of these forces, Nij accounts for the superposition of loads and moments and the additive effects on injury risks.

Making the transition: Advanced airbags meeting the new standard will be required starting with 2004 model vehicles. Automakers will be required to certify an increasing percentage of their fleet each year, and all new vehicles must comply after August 2006. Starting in 2007, an increasing percentage of all new vehicles will have to pass the rigid-barrier crash test with belted male dummies at 35 instead of 30 mph — a requirement that will be fully implemented by 2010.

NHTSA originally planned to phase in the new requirements starting with 2003 model year vehicles. With the number of new requirements, it now considers the additional lead time essential.

The strength of the new standard is that it will require minimum levels of protection for unbelted and belted occupants in high-speed crashes and at the same time reduce the risks of airbag-induced injuries to out-of-position occupants. It's important to recognize, however, that it will not guarantee inflating airbags pose no risks. New required warning labels in vehicles convey a similar message.

Summary of new

test dummies, injury criteria

Besides a plethora of new tests (see charts on pp. 2-3), the airbag standard issued recently calls for four new test dummies in addition to the average-size (50th percentile) adult male already used in airbag testing:

- small (5th percentile) adult female
- 6-year-old child
- 3-year-old child
- 1-year-old infant

Some measures of injury likelihood also will change or expand:

- Pelvis/upper leg injury criterion unchanged (10 kN)
- Chest acceleration measure unchanged (60 g)
- Chest deflection will change from 76 mm to 63 mm
- HIC will change from 1,000 over 36 ms to 700 over 15 ms
- Neck injury measure (Nij) will be added

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Long-awaited airbag standard specifies new tests, including full-scale crash tests, plus new dummies, injury criteria, and morep.1

Summary of new airbag testsp.2

Debate about testing at 25 vs. 30 mph with unbelted dummies dominates the airbag rule-making processp.4

Driver and passenger airbag deaths confirmed as of May 1, 2000p.5

Test dummies and injury criteria under the new federal rulep.7



Science prevails

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